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Edison

SYSTEM of

ELECTRIC RAILWAYS

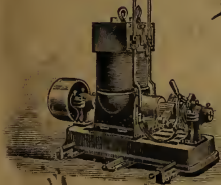
BARTLETT & CO. N.Y.

Edison General Electric Co.

EDISON BUILDING,

BROAD ST.
NEW-YORK.

1891





EDISON SYSTEM
OF
ELECTRIC RAILWAYS.

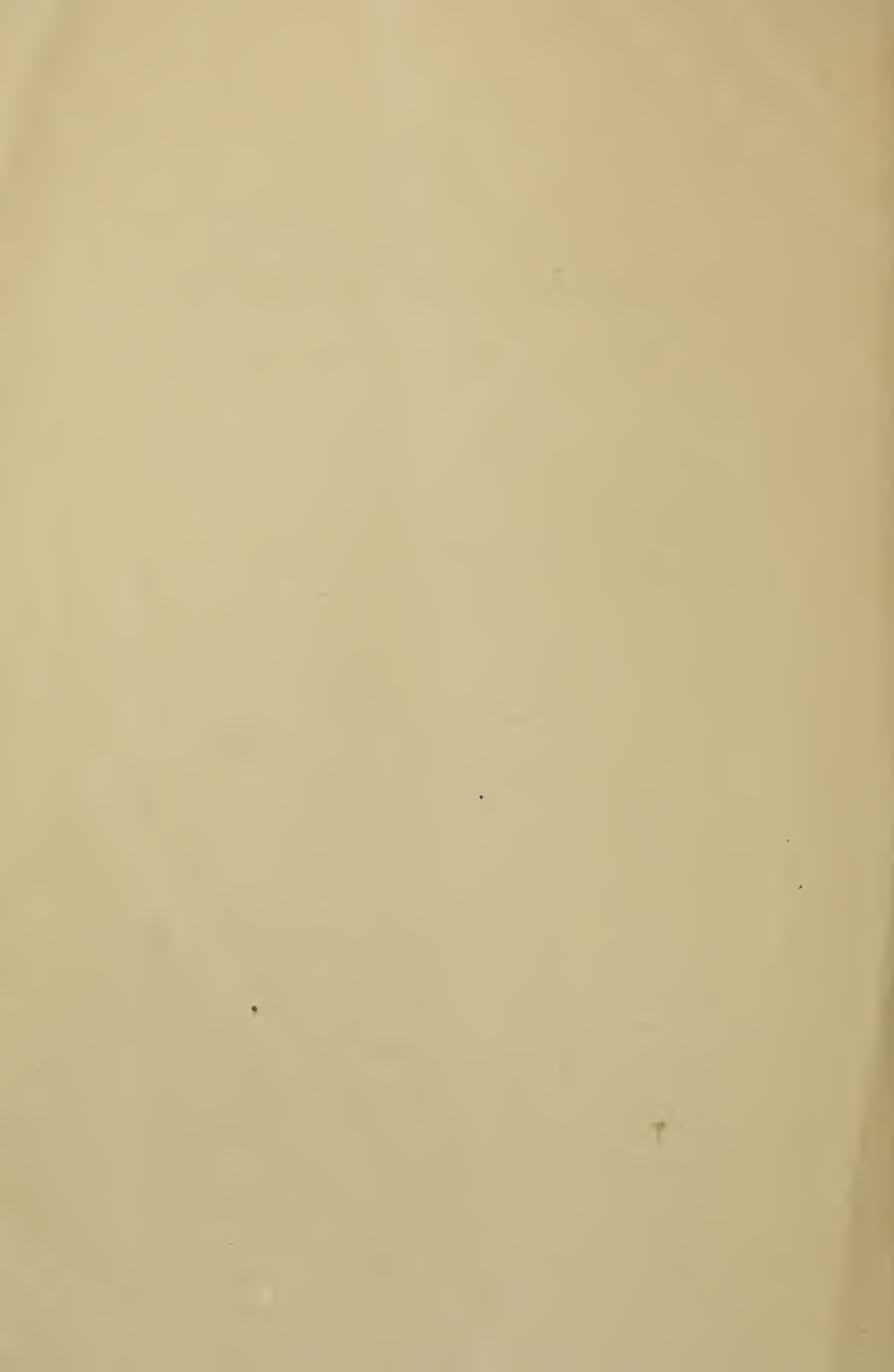
Edison General Electric Co.,

Edison Building,

BROAD STREET, NEW YORK.

MAY, 1891.

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The Edison Overhead System for Electric Railway Work.

The overhead trolley wire for the conveyance of the energy of the dynamos to the motors upon the cars of street railways is the only method yet devised which is thoroughly satisfactory.

Underground conduits for the bare wire or working conductor, though put in without regard to cost, and given every opportunity for success, when practically operated and subjected to rain, snow, mud, ice and the accidents of everyday use, have in most instances proved to be failures. In Boston and other cities, where they have been installed on a large scale, their use has been abandoned for the present. The underground conduit with an open slot is necessarily more complicated and is liable to interruptions during heavy storms, owing to the difficulty of drainage.

The feeder wires or main conductors are now in many cases placed underground in waterproof insulated tubes, leaving only the trolley wire or working conductor suspended over the track. This construction is now used by the Edison Company where objections are raised to the ordinary overhead methods, and has been in successful practical operation for a long time on several of the most extensive plants in the country.

The most economical and practical method of current distribution now in use, is the Single Trolley overhead system, and that system of overhead wiring for railway purposes, which is the least obtrusive, the lightest, and the least complicated, is the most desirable.

The Feeder System.

The distribution circuit of the Edison System is the most simple, the most reliable and least unsightly of any yet devised, and has characteristics which are covered by fundamental Letters Patent.

It is practically impossible to distribute electricity over a large system and keep the pressure approximately constant at the various points of the line without using the feeder system, or a modification of it.

The cars can be run nearly as fast at the most distant points from the power station as they can close to it. With the feeder system the cars can be operated satisfactorily with a smaller loss of power on the line than where the trolley wire is the only conductor.

The overhead work is divided into sections so that if an accident occurs only the cars on the section affected are stopped. The heavy grades or curves of the line are reinforced by feeders so that the motors obtain the power necessary to perform the extra duty required of them at such points.

It is a well known fact that by the Edison System cars can be operated with a much less expenditure of electrical power than by any other system. This means a saving of fuel, and a reduction in the size and cost of the power plant. In other words, the cost of operation per passenger carried or per car mile operated will be less, and the the fixed charges for interest, etc., dependent upon the capital invested will also be reduced.

Overhead and Ground Circuits.

In the Edison System the electric circuit consists of two parts, the overhead and the ground circuit.

In providing for the return of the current, the rails are grounded and form one side of the circuit. They are tied together by iron wires riveted to each rail end and properly connected.

The other side of the circuit consists, in part, of a hard drawn silicon bronze wire of small size but great tensile strength, which is suspended from seventeen to twenty feet above the track.

This trolley wire, or working conductor, is carried over the centre of the track by span wires running from pole to pole across the street, or by brackets attached to poles set on one side only. When the streets are broad and double tracks are used, the poles may be set between the tracks with bracket arms extending on both sides. No change in the size of the trolley wire is required with increase in the number of cars, or an extension of the line.

The size of the trolley wire is entirely independent of the number of cars to be operated or the length of the line, since the main portion of the current is carried in a main line wire or conductor running parallel to it, and connected to it at intervals of 400 to 500 feet by sub feed-in wires.

This main wire is of a size sufficient to carry the current necessary to operate all the cars over the entire length of line, up all the grades, with the maximum number of passengers, and is itself supplied, at suitable points, by reinforcing feed wires connected directly with the station.

Reliability of Service.

By the use of parallel conductors, and by means of special cutouts for line sections, the power can (even in case of an accident to the line) always be furnished to the cars, except immediately at the point of breakage.

Light Overhead Supporting Wires Possible.

The main conductor wire being carried upon the poles themselves, the span wires are not subjected to the enormous strain which is inevitable when the current is carried solely in the working conductor or trolley wire, because of the large size of wire necessary in that case.

System of Cutouts for Lines Sections.

In any system of distribution safety devices are interposed between the dynamos and the outside circuit, as a protection from injury due to a sudden overload caused by accidents to the line.

In addition to these main cutouts or safety devices the overhead work of the Edison System has cutouts interposed at the intersection of every lateral or sub-feeder with the main feeder, thereby furnishing additional protection to the station equipment as well as to the line. Fusible cutouts are also inserted at each end of every reinforcing feeder from the station.

POWER GENERATION.

The marked favor in which the Edison generator is held is sufficient guarantee of their electrical and mechanical construction. They are economical in floor space, and the centre of gravity of the moving parts being low, insures perfect freedom from vibration. Their commercial efficiency is over 90 per cent.

The self-oiling bearings run practically without attention, the oil requiring renewal only about once in six weeks.

A novel feature which has been introduced by the Edison Company into Power Station Equipment is the Controlling Table.

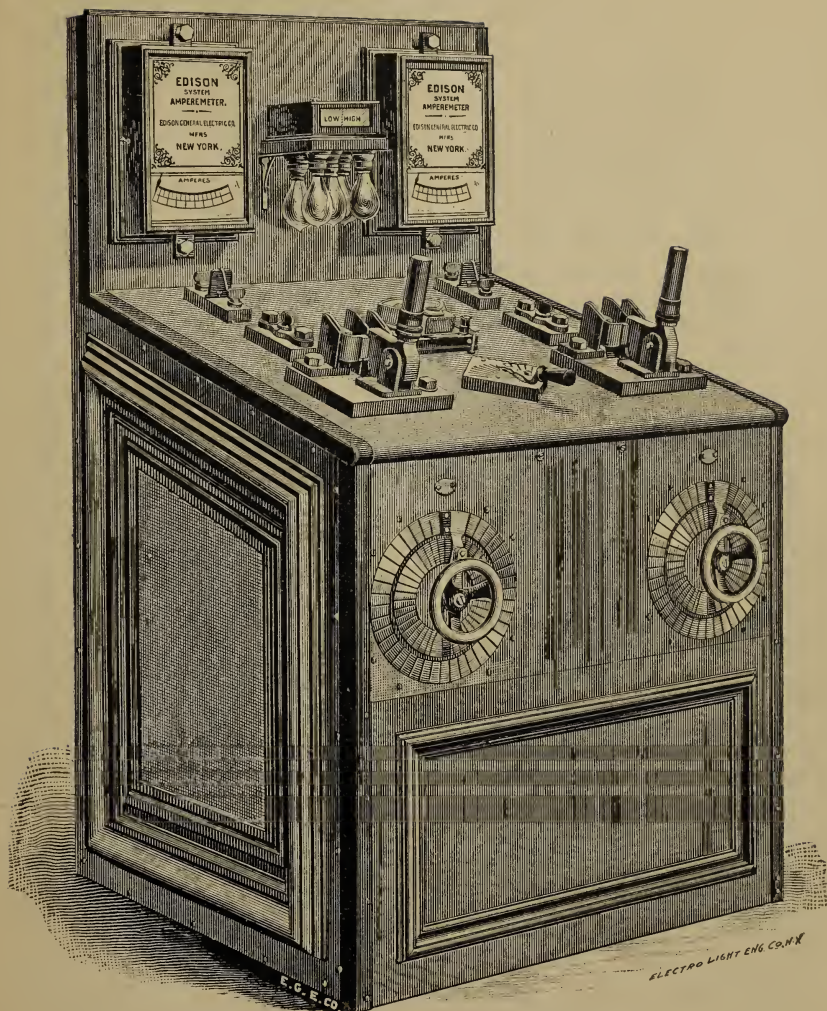
These tables are manufactured in sections, and have all the necessary Station instruments mounted compactly upon them. When any addition to the plant is desired, additional sections containing the necessary additional instruments can be supplied, which can be placed in position and connected up in a very few hours, thereby avoiding the delays caused by the additional wiring, and extension of the existing switch-board.

These tables are constructed of slate or other fire-proof material.

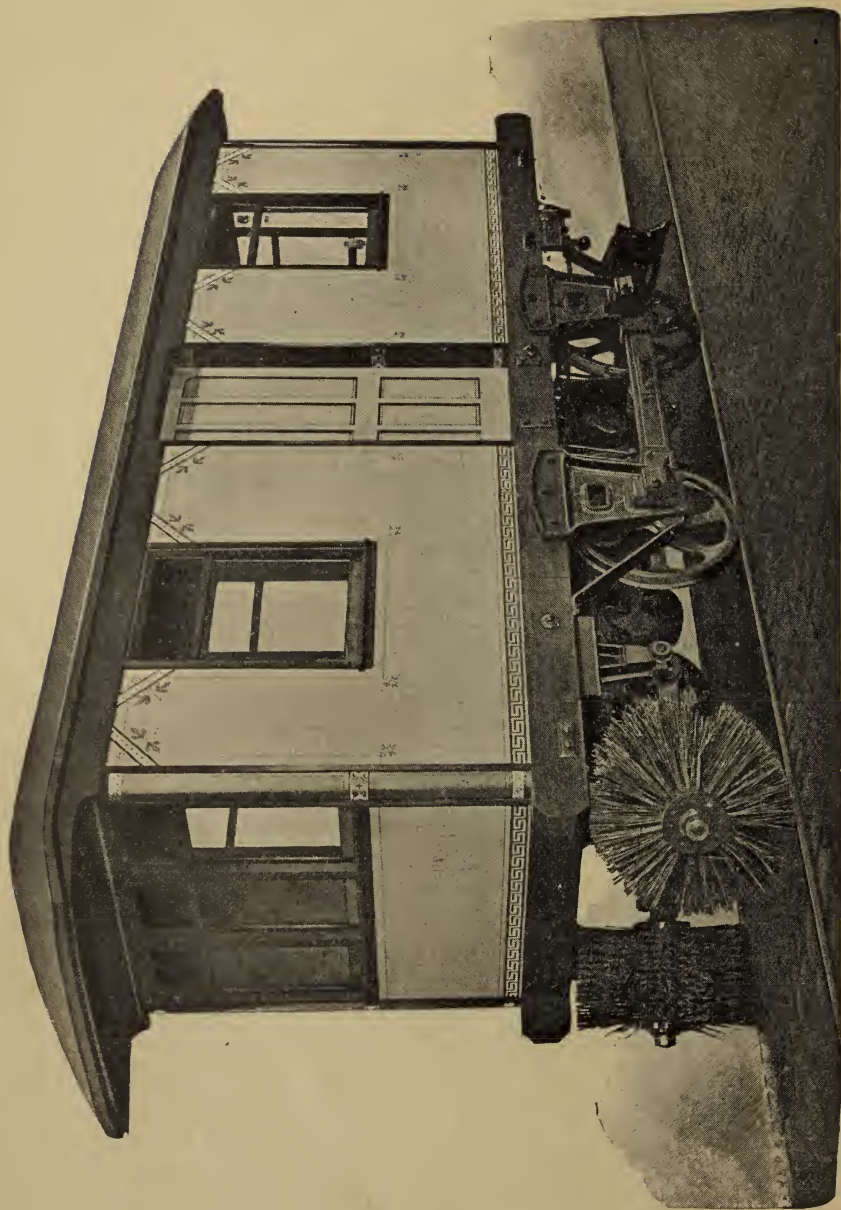
Sectional Feeder Boards with the necessary instruments are also supplied when required.

CAR EQUIPMENT.

In the Edison System the motors are supported and centered upon the axles at one end and carried by flexible support or suspension springs at the other, thus relieving the motor from sudden jars or strains in starting or reversing of the motor.



EDISON CONTROLLING TABLE FOR ELECTRIC RAILWAY POWER STATIONS.



EDISON SNOW PLOW AND SWEEPER.

The speed of the motor is governed by a peculiar controlling switch, which, by varying the position of the lever, changes the relations between the armature and field coils so that their electrical combinations are altered, thereby varying the speed, without the use of external resistances.

Both motors are simultaneously controlled from either end of the car, by a single movement of the switch lever, making the handling of the cars extremely simple; the driver or motor man requires little more instruction than is necessary when learning to drive a horse car.

The field coils of the motor are wound on separate spools of insulating material, which spools can be readily replaced if necessary.

The armatures are wound with the greatest care, several weeks being required to complete them.

In case of accident or danger to human life the motors can be **instantly** reversed, whereas in other systems two or three distinct operations are necessary before a car can be stopped and the motors reversed, thereby increasing the risk of accident.

Our double equipments are fitted with a cutout switch by which the man in charge of the car can cut out either one of the motors in case it is disabled and thus enable the car to complete the trip with the other motor.

Snow.

In case of heavy snow storms trouble may be avoided by the use of a properly constructed snow plow, propelled by two 15 H. P. or larger motors, and having sweepers operated by an additional motor properly connected to them, the whole of the machinery being easily handled and under the direct control of the man in charge. A cut of the Edison snow plow will be found on the opposite page.

LINE CONSTRUCTION.

Much time and study have been spent in obtaining the lightest, strongest and least unsightly overhead

construction possible, and the line appliances and material for construction now used by the Edison Company give a structure at once simple, reliable and elegant.

The small size of the silicon bronze wire suspended over the track reduces the breakage of span wires and the sagging of the poles, to minimum. The use of feeders and cutouts prevent the accidental breakage of a trolley wire from stopping the whole system.

Guard Wires.

To avoid accidents and burnouts caused by broken telephone, telegraph and electric light wires falling across the bare trolley wire, guard wires are erected above the latter wherever necessary, thus preventing vexatious delays and costly repairs.

The foregoing statements are borne out by the successful operation of roads equipped with the Edison System in all parts of the country, and in many instances the satisfaction of the local companies is shown in a practical manner by a second, third, and sometimes a fourth order for additional equipment.

THE EDISON 25 H. P. SINGLE REDUCTION STREET CAR MOTOR.

Although the application of the high speed electric motor conveying power to the car axle by a double reduction gear has demonstrated beyond question the practicability and economy of electric railroading, it has become evident that improvement could be effected by the elimination of some of the gearing heretofore employed. The modification necessary to accomplish this purpose, readily suggests itself in the reduction of the initial speed of the motor and the employment of a single reduction only between the motor and the car axle. As the power of the motor is the product of the

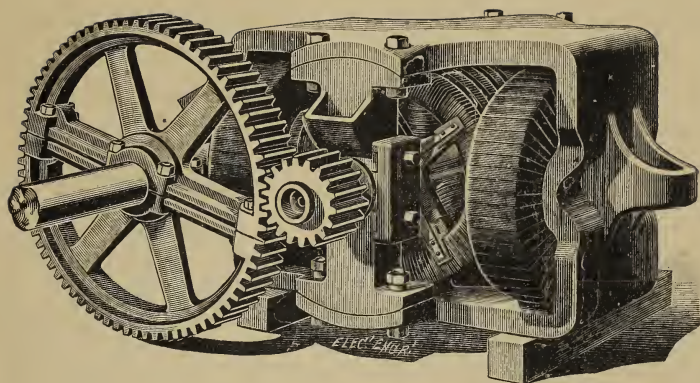


FIG. 1.

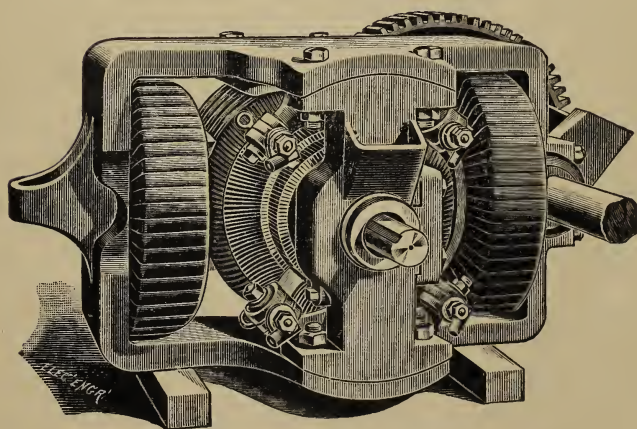


FIG. 2.

EDISON SINGLE REDUCTION STREET CAR MOTOR.

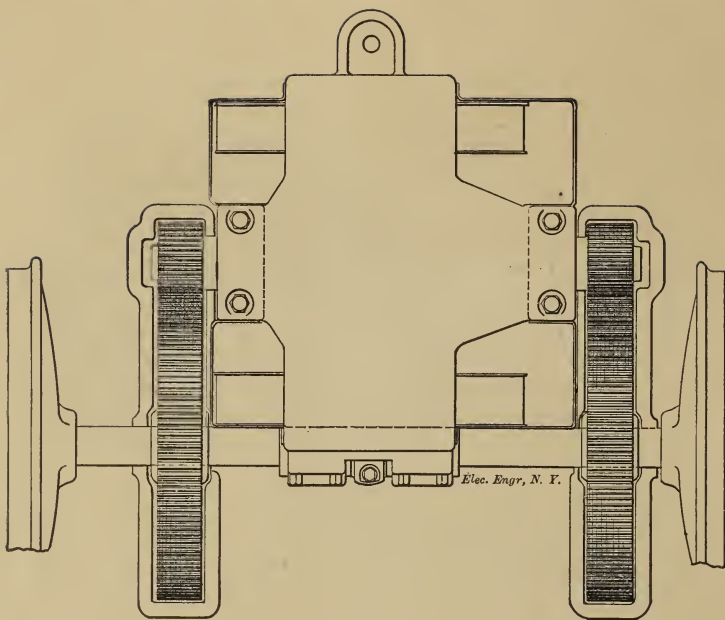


FIG. 3.

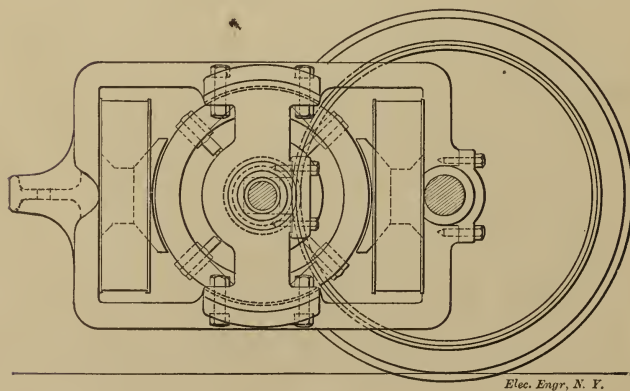


FIG. 4.

EDISON SINGLE REDUCTION STREET CAR MOTOR.

torque into the speed, the application of the slow speed motor necessitates a construction such that the torque of the motor shall be increased in the same proportion as its speed is reduced. This is best carried out in the multipolar machine, and in keeping with the progress going on in their other departments, the Edison General Electric Company are now building a type of single reduction street car motor which embodies several novel features.

In our illustrations of this machine, Figs. 1 and 2, the motor is shown in perspective as seen from either end of the armature, the gears being removed from the shaft in Fig. 2 in order to expose the commutator and brush arrangement. The more detailed construction of the motor is shown in Figs. 3 and 4, from which it will be seen that the machine is of the four-pole type and practically iron-clad. Only two poles, those in the horizontal plane, are wound, the two in the vertical plane being magnetized by induction from the same spools and forming, as it were, consequent poles of opposite polarity. The entire field, consisting of special soft cast-steel, is made in one casting with the exception of the pole pieces which are attached by screw bolts after the spools have been slipped on over the straight cores at the sides. These pole pieces, it will be noted, extend for a short distance beyond the field coils, and practically 80 per cent. of the whole spool is surrounded by iron. As a result of this construction and the employment of cast-steel, the magnetizing force required to attain the proper degree of magnetization is small, and from the nature of the construction there is little magnetism which is not utilized.

The magnetizing coils are wound in three sections on vulcabeston spools, which, as stated above, are slipped on over the cores. In the construction of the machine the facing of the armature bearing and the cylindrical armature space are bored out at one boring, and by loosening two bolts the armature can be slipped out completely, so that inspection can be effected with great facility. The armature, which is of the Gramme type, is built up of punched soft iron rings insulated

from each other, and with the end plates of wrought iron and bevelled. On the interior diameter of the hollow cylinder built up in this manner, there are four grooves placed 90° from each other, and into these grooves the aluminum-bronze spiders are pressed by hydraulic pressure, two spiders being employed and bolted together. In this way a firm mechanical connection is made between the armature shaft and the ring.

The diameter of the armature is 18 inches, and its length 13 inches. The shaft is 3 inches in diameter, and upon each end is mounted a pinion which meshes with the large gears at each end of the axle, thus equalizing the power on the axle. One end of the magnet forms the car axle bearing and the other is suspended by a spring at the nozzle for easy starting. The commutator has been made specially large, being 10 inches in diameter.

The armature is wound in 140 sections, and on account of the strong field employed, and the method of connection to the commutator, no spark is observed. The winding is put on in one continuous length of wire, and at each section a tap wire of German silver is taken to the commutator. The object of employing a German silver wire will become obvious when it is pointed out that, as is well known, the brush in passing from one commutator segment to another short-circuits the coil between them for an instant. The introduction of the German silver wire with its increased resistance reduces the current induced by the short circuit considerably, and, hence, the sparking due to that cause; and it also aids materially in cutting down the current, if by any accident the motor should be accidentally short circuited. It will be evident, however, that in the operation of the machine only those two German silver wires are in circuit which lead from the commutator segments immediately under the brushes, all the others being, of course, without current during the period between their travel from one brush to the other; hence, although the introduction of these two short lengths of German silver wire has no appreciable effect upon the normal operation of the armature it affords a simple method of avoiding sparking and danger from short circuits. The en-

tire machine is encased in a water-tight cover, and its total weight with gears is about 2,200 pounds. The machine is rated at 25 H. P., but will readily develop 30 H. P. It is intended to apply two of these machines to each car of the double truck type, while one machine alone will be ample to drive the smaller cars. The motor is of the series type and the regulation is effected by varying the combination of the fields, which are wound in three sections. By this method of regulation the use of a rheostat is avoided.

Four carbon brushes are employed, and the brush holders being rigidly fastened to the frame, require no shifting throughout the range of load to which the motor is subjected. The motor is calculated to revolve at 460 revolutions with the car running at a speed of 12 miles an hour.

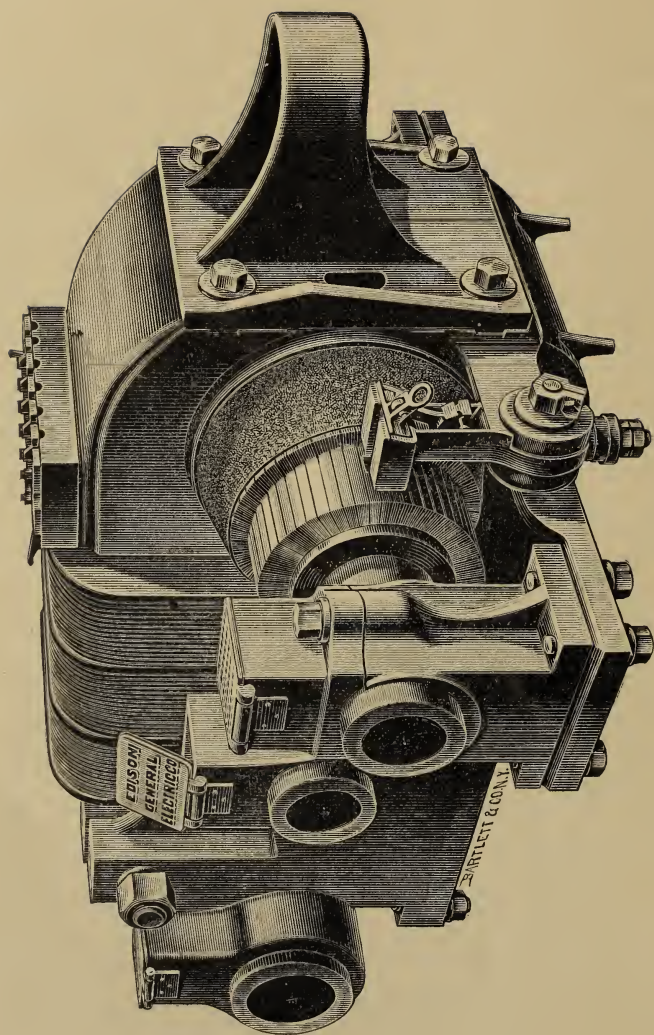
THE EDISON 15 H. P. SINGLE REDUCTION MOTOR.

A 15 H. P. single reduction iron clad motor of the same type and construction is manufactured by the Edison Company for use on level roads or light track where smaller machines are required at a lower cost.

15 H. P. DOUBLE REDUCTION MOTORS FOR STREET RAILWAY WORK.

The Edison Company now manufacture a new type of 15 H. P. Double Reduction Motor, designated No. 8, which is much stronger and stiffer than the older machines.

This motor also contains several improvements, is very compact in construction, and will operate easily on narrow guage roads. It has a better form of armature bearings, superior arrangement of lubricating appliances, a stronger and simpler method of attaching the brush holders, a larger and improved commutator, and is used two motors to a car, connected in series, thus dividing the load equally between the two motors, and is, without the complication of equalizing coils, equal in every respect to the No. 6 in all ordinary duties required in operating standard street cars.



EDISON (No. 8) 15 H. P. DOUBLE REDUCTION STREET CAR MOTOR.

With the No. 8 motor a car can be operated at the slowest possible movement for starting, and up to a maximum of 9 to 15 miles per hour, according to ratio of gearing employed.

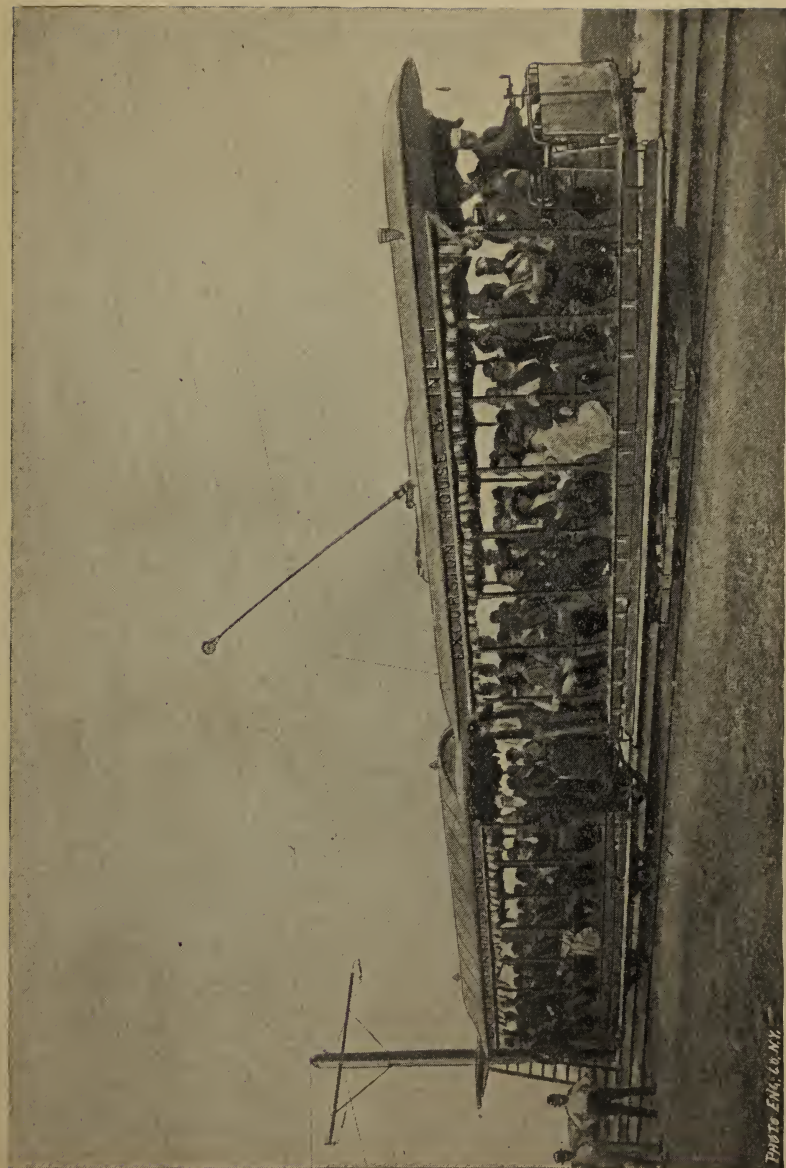
The motors being operated in series, the work is exactly equalized between the two motors; and each motor being under only 250 volts pressure, they are much less liable to electrical faults than other motors.

In practical work with over 200 motors they have proven to be thoroughly reliable, in fact, we have no reports of accidents to this machine.

Owing to the reduced voltage on the machines, possibility of accident is reduced to a minimum, and therefore the method described above commends itself to all practical men as the most economical and satisfactory.

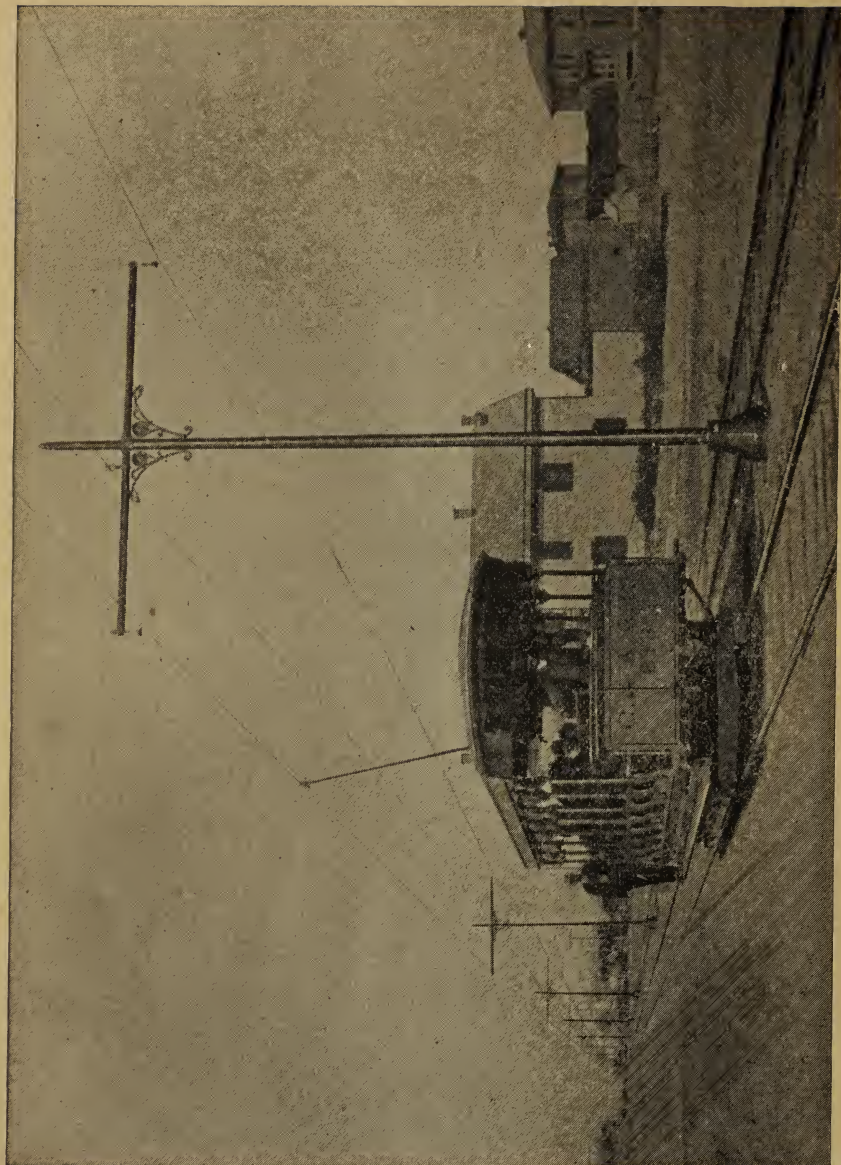


EDISON ELECTRIC RAILWAY CINCINNATI O.



EDISON ELECTRIC RAILWAY, ATLANTIC CITY, N. J.

Photo E. H. Co. N.Y.



EDISON ELECTRIC RAILWAY, ATLANTIC CITY N. J.

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